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Abstract

This paper analyses the trend in economic growth and population transition in China and India during 1990-2018 through a comparative perspective. The analysis follows a decomposition framework which argues that economic growth has a pure demographic component and a pure economic component and it is the latter which actually contributes to improving the standard of living. Using the data available through the World Bank, United Nations Population Division and International Labour Organization, the paper reveals that most of the economic growth in China during 1990-2018 has contributed to improving the standard of living. By contrast, a substantial proportion of economic growth in India has been the result of the demographic factors that contribute little to improve the quality of life of the people. The paper concludes that China needs to explore possibilities of productive utilisation of the old people to sustain economic growth whereas India requires reinvigorating the economic system and accelerating population transition to improve the quality of life of its people.

Key Words

Economic growth, population transition, China, India, standard of living

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Introduction

China and India are the only two billion plus countries in the world. According to the latest estimates prepared by the United Nations Population Division, the two countries account for 2.7803 million or almost 36 per cent of the world population in 2020 (United Nations, 2019). The two countries, however, differ radically in terms of population transition and economic growth. China has already reached an advanced stage of population transition with an estimated average annual population growth rate of 0.456 per cent per year during the period 2015-2020 and total fertility rate well below the replacement level (1.69 births per woman of reproductive age). India, on the other hand, is still stuck-up in the middle of the population transition path with an average annual population growth rate of 1.039 per cent per year during the period 2015-2020 and fertility still above the replacement level (2.24 births per woman of reproductive age) according to estimates prepared by the United Nations Population Division (United Nations, 2019). It is projected that India is the most likely to surpass the population of China by the year 2027 to become the most populous country of the world (United Nations, 2019).

The two countries have also been the most rapidly growing economies of the world since 1990 but the growth of Chinese economy has been substantially faster than that of India during 1990-2018. According to the estimates prepared by the World Bank, the real total output of China's economy increased at an average annual rate of more than 9 per cent per year during the period 1990-2018. By comparison, India's economy grew at an average annual rate of around 6 per cent per year during the same period. In 2018, the total output of China was estimated to be more than 10797 billion 2010 US $ compared to India's output of around 2842 billion. In 1990, the labour productivity, measured in terms of real total output per labour force, in China was lower than the labour productivity in India. However, by the year 2018, the labour productivity in China became more than 2.5 times higher that in India.

In both countries, economic and population factors have contributed to the growth of the economy. Piketty (2014, pp72) has argued that the output of the economy can be decomposed into two components - a pure demographic component and a pure economic component - and it is only the latter that allows for improvement in the standard of living of the people. The demographic component is determined by the population stock - the size and the age composition of the population. The economic component, on the other hand, is determined by the labour productivity and the participation opportunity. The growth in the output of the economy should, therefore, be analysed in terms of population growth; transition in population age composition; change in the labour productivity; and change in the participation opportunity. Such an analysis helps in understanding the relative contribution of population and economic factors to economic growth and how the relative contribution of these factors have changed over time.

In this paper, we analyse population transition and economic growth in China and India during 1990-2018 through a comparative perspective. By population transition, we mean the change in the population stock - the size and the age composition of the population. It is well-known that population transition leads to the increase in the size and ageing of the population. The implications of the increase in population size for economic growth have been debated for decades (Birdsall, Kelly, Sinding, 2001; Bloom, Canning, Sevilla, 2001, Heady and Hodge, 2009). This debate can be synthesised in terms of three alternative positions - population growth restricts, promotes, or is independent of economic growth. Proponents of each position have empirical evidence to support their case. The issue is, however, complicated as the relationship between population growth and economic growth is found to be different in the developing as compared to the developed countries (Kelly, 2001).

On the other hand, ageing of the population associated with population transition also impacts economic growth because the economic behaviour of the people varies by age. Population with high proportion of child population requires high investment on children which tends to depress economic growth. On the other hand, if a large proportion of the population is concentrated in working ages, then the added productivity of the working population can produce a demographic dividend that can accelerate economic growth (Bloom, Canning, Sevilla, 2001). Bloom and Williamson (1998) were the first to demonstrate the key role played by the transition in the population age composition in accelerating economic growth in selected East Asian countries. Subsequently, many studies have been carried out globally to highlight the contribution of the transition in the age composition of the population to the economic growth (Bloom, Canning and Sevilla, 2008; 2011; Golley, 2017; Joe, 2011; Mason, 2008; Prskawetz, 2007; Ranganathan, 2017; Wang, 2013).

The demographic dividend resulting from the transition in the age composition of the population has been further classified as the first and the second demographic dividend. (Lee, Mason, Miller, 2000; Mason, 2005; Lee and Mason, 2006). The first demographic dividend occurs when the working age population raises relatively fewer number of children so that increased resources are available for investment in the economy. This increased investment spurs economic growth. This dividend is essentially transitory in nature. It turns negative at the latter stages of population transition because of the decrease in the working age population and rapid increase in the old age population. The second demographic dividend, on the other hand, is the result of the tendency of the people to create assets and accumulate wealth as they get older. Asset creation and wealth accumulation also leads to increased investment in the economy and spurring economic growth. The second dividend depends upon the first and begins somewhat later than the first. However, it is not transitory in nature and can continue indefinitely.

There are many studies that have analysed population and economy of China and India through a comparative perspective (Wolf et al, 2011; Golley and Tyres, 2013; Choudhry and Elhorst, 2010; Bloom et al, 2006). In this paper, we explore the simultaneous effect of the change in the four factors of economic growth - population size; population age composition; labour productivity; and participation opportunity - on economic growth of the two countries. We

2

decompose the growth in the output of the economy into the growth attributed to the change in population size; transition in the age composition of the population; increase in the labour productivity; and the change in the participation opportunity. The framework helps in understanding how demographic and economic factors have contributed in shaping the growth of the economy of the two countries during 1990 through 2018. The paper follows the arguments put forward by Piketty (2014) to analyse the contribution of demographic and economic factors in the expansion of the economy of the two countries.

The paper is organised as follows. The next section of the paper outlines the analytical framework used in the present analysis which is essentially the factor decomposition approach. Section three describes the data that constitute the basis for the analysis. Section four describes, briefly, the growth in the output of the economy of the two countries along with the transition in the factors that determine the size and growth of the output for the period 1990 through 2018. Section six presents and discusses results of the decomposition exercise. The last section of the paper discusses the demographic imperatives for India and states/Union Territories in the context of economic growth.

Analytical Framework

Let Y denotes the gross domestic product (GDP) at constant prices and P denotes the population. Then, Y is the product of the population (P) and the per capita real GDP or the output.

$$Y = P * \frac{Y}{P} \tag{1}$$

The per capita output may further be written as

$$\frac{Y}{P} = \frac{Y}{L} * \frac{L}{W} * \frac{W}{P} \tag{2}$$

Here, L is the labour force or the number of people engaged in productive activities and W is the working age (15-59 years) population. Combining equations (1) and (2), we get

$$Y = P * \frac{Y}{L} * \frac{L}{W} * \frac{W}{P}$$

$$Y = \left(P * \frac{W}{P} \right) * \left(\frac{Y}{L} * \frac{L}{W} \right) \tag{3}$$

The first term on the right of equation (3) reflects the demographic component of the output of the economy while the second reflects the economic component. The economic component comprises of two factors - labour productivity (Y/L) and participation opportunity (L/W). Both these factors are influenced by the state of the social and economic production system. On the other hand, the demographic component also comprises of two factors - population size (P) and the ratio of the working age population to the total population (W/P). Both these factors reflect the stage of population transition.

Based on equation (3), the growth in the output of the economy may be measured in both relative and absolute terms. Let $D=(W/P)$, $I=(Y/L)$ and $E=(L/W)$, then, the relative growth in the output of the economy may be decomposed as

$$(Y_2/Y_1) = (P_2/P_1)*(D_2/D_1)*(I_2/I_1)*(O_2/O_1) \tag{4}$$

or

$$\ln(Y_2/Y_1) = \ln(P_2/P_1)+\ln(D_2/D_1)+\ln(I_2/I_1)+\ln(O_2/O_1) \tag{5}$$

or

$$r_Y = r_P + r_D + r_I + r_O \tag{6}$$

where

$$r_Y = \ln\left(\frac{Y_2}{Y_1}\right), \text{ etc.}$$

denotes the relative growth of the real total output of the economy between two points in time.

On the other hand, following Ang (2016), the absolute growth in the real output of the economy may be decomposed as

$$\nabla Y = Y_2 - Y_1 = \frac{(Y_2 - Y_1)}{(\ln(Y_2) - \ln(Y_1))} * (\ln(Y_2) - \ln(Y_1)) \tag{7}$$

But,

$$\ln(Y_2) - \ln(Y_1) = \ln(P_2 * D_2 * I_2 * O_2) - \ln(P_1 * D_1 * I_1 * O_1),$$
$$= \ln(P_2 - P_1) + \ln(D_2 - D_1) + \ln(I_2 - I_1) + \ln(O_2 - O_1) \tag{8}$$

substituting from (5) in (4), we get

$$\begin{aligned}
\nabla Y = Y_2 - Y_1 = & \frac{(Y_2 - Y_1)}{(\ln(Y_2) - \ln(Y_1))} * (\ln(P_2) - \ln(P_1)) + \\
& + \frac{(Y_2 - Y_1)}{(\ln(Y_2) - \ln(Y_1))} * (\ln(D_2) - \ln(D_1)) + \\
& + \frac{(Y_2 - Y_1)}{(\ln(Y_2) - \ln(Y_1))} * (\ln(I_2) - \ln(I_1)) + \\
& + \frac{(Y_2 - Y_1)}{(\ln(Y_2) - \ln(Y_1))} * (\ln(E_2) - \ln(E_1))
\end{aligned} \tag{9}$$

or

$$\nabla Y = \partial P + \partial D + \partial I + \partial E \tag{10}$$

The growth in the real output of the economy attributed to the factor D, ∂D, in equation (10) is popularly known as the demographic dividend. The demographic component (DC) of the growth in the total output of the economy of any country may now be estimated as

$$DC = \partial P + \partial D \tag{11}$$

whereas the economic component (EC) may be estimated as

4

$$EC = \partial I + \partial E \tag{12}$$

Arguing in a similar manner, if Y_C denotes the total output of China and Y_I denotes the total output of India, then the relative difference in the rate of growth in the real total output of the economy between the two countries can be decomposed as

$$\frac{Y_{C_2}/Y_{C_1}}{Y_{I_2}/Y_{I_1}} = \frac{P_{C_2}/P_{C_1}}{P_{I_2}/P_{I_1}} \times \frac{D_{C_2}/D_{C_1}}{D_{I_2}/D_{I_1}} \times \frac{I_{C_2}/I_{C_1}}{I_{I_2}/I_{I_1}} \times \frac{O_{C_2}/O_{C_1}}{O_{I_2}/O_{I_1}} \tag{13}$$

or

$$\nabla r_Y = \nabla r_P + \nabla r_D + \nabla r_I + \nabla r_O \tag{14}$$

where

$$\nabla r_Y = \ln\left(\frac{Y_{C_2}/Y_{C_1}}{Y_{I_2}/Y_{I_1}}\right) \tag{15}$$

is the difference between the rate of growth of the real total output of the two countries.

On the other hand, the absolute difference in the total output of the economy of the two countries can be decomposed as

$$\nabla Y = Y_C - Y_I = \frac{Y_C - Y_I}{(\ln(Y_C) - \ln(Y_I))} \times (\ln(P_C) - \ln(P_I)) +$$

$$+ \frac{Y_C - Y_I}{(\ln(Y_C) - \ln(Y_I))} \times (\ln(D_C) - \ln(D_I)) +$$

$$\frac{Y_C - Y_I}{(\ln(Y_C) - \ln(Y_I))} \times (\ln(I_C) - \ln(I_I)) +$$

$$+ \frac{Y_C - Y_I}{(\ln(Y_C) - \ln(Y_I))} \times (\ln(O_C) - \ln(O_I)) \tag{16}$$

Where the term $[(Y_C-Y_I)/(\ln(Y_C)-\ln(Y_I))]$ is defined as the logarithmic mean of the real total output of the two countries.

Data Source

The data for the present analysis have been taken from three sources. Estimates of the total output of the economy (Y) at constant 2010 US $ for different years of the period 1990 through 2018 are taken from the database maintained by the World Bank. On the other hand, annual estimates of the total population (P) and the working age population (population aged 15-59 years) (W) are taken from the latest population estimates and projections prepared by the United Nations Population Division for different countries of the world (United Nations, 2019). Finally, estimates of the size of the labour force (L) in the two countries are taken from the database maintained by the International Labour Organization and are

available annually since 1990 onwards. Annual estimates of the size of the labour force prepared by the International Labour Organization are actually modelled estimates. The details of the methodology adopted by the International Labour Organization for preparing these estimates are given elsewhere (ILO, 2020). Official estimates of the total output of the economy of the two countries as well as official estimates of the population size, working age population and labout force have not been used in the present analysis because of the problems in the comparability of the estimates of the two countries. Another problem is that estimates of the population size and the working age population may not be available on an annual basis as required in the present analysis.

Economic Growth in China and India

According to the estimates of the real total output of the economy prepared by the World Bank, economic growth in China has been significantly more rapid than that of India during the period under reference. The real total output of China's economy, at constant 2010 US $, increased from almost 828 billion in 1990 to more than 10797 billion in 2018 at an average annual growth rate of more than 9 per cent per year over a period of 28 years. By contrast, the real total output of India's economy increased from around 508 billion constant 2010 US $ in 1990 to 2842 billion constant 2010 US $ in 2018 at an average annual growth rate of around 6 per cent per year. As the result of the differing pace of growth, the gap in the size of the two economies increased from 320 billion constant 2010 US $ in 1990 to 7956 billion constant 2010 US $ in 2018. In 1990, China's economy was around 1.6 times larger than the Indian economy but, by 2013, China's economy became more than 3.9 times larger than the Indian economy. After 2013, the expansion of India's economy has been relatively faster than the Chinese economy so that the gap between the size of the two economies decreased marginally. However, in 2018, China's economy was estimated to be around 3.8 times larger than the Indian economy.

In both countries, the annual percentage growth in the real total output of the economy fluctuated sharply during the period under reference. This implies that external factors that influence the output of the economy varied frequently in both countries. More specifically, during the 28 years between 1990 and 2018, the annual percentage growth in the real total output of China's economy was never less than 6 per cent but more than 13 per cent in 1992 and again in 2007. Moreover, China's economy recorded double-digit growth in 8 of the 28 years under reference. However, the annual percentage growth in the real output of the economy of the country started decreasing since 2010 and the annual percentage growth in the real output of China's economy during 2017-2018 has been estimated to be the slowest of the 28 years between 1990 and 2018.

By comparison, the annual percentage growth in the real output of India's economy has always been less than 10 per cent during the 28 years under reference. The expansion of India's economy was the most rapid during 1999 and again during 2010 when the real total output of the economy of the country increased by more than 8 per cent. By contrast, the economy of the country grew very slowly during 1991 when the real total output of the economy of the country increased by just

6

around 1 per cent. In 6 of the 28 years under reference, the annual percentage growth in the real total output of India's economy was estimated to be less than 5 per cent. The period 2003 through 2007 appears to be the golden-era for the Indian economy as the annual percentage growth in the real total output of the economy of the country was consistently more than 7.5 per cent during this period. After 2011 also, the annual percentage growth in the real output of India's economy accelerated consistently till 2016 but, after 2016, it again showed a decreasing trend.

The annual percentage growth in the real total output of China's economy has, however, not always been higher than the annual percentage growth in the real total output of India's economy during the 28 years between 1990 and 2018. The annual percentage growth in the real total output of India's economy was estimated to be higher than the annual percentage growth in the real total output of China's economy in 1999. More importantly, after 2013, the annual percentage growth in the real output of India's economy has consistently been higher than the annual percentage growth in the economy of China, although the difference between the two fluctuated. The annual percentage growth in the real output of the economy of China was, however, very high compared to the average annual percentage growth in the real total output of the economy of India during the period 1991-93 with the gap between the two being the widest in 1993 when the annual percentage growth in the real output of China's economy was almost 13 per cent whereas the average percentage growth in the real output of India's economy was estimated to be less than 5 per cent.

Population Transition in China and India

The population stock of China increased by more than 250 million between 1990 and 2018 at an average annual rate of increase of 0.69 per cent per year according to the estimates prepared by the United Nations Population Division. By comparison, India's population increased by close to 480 million at an average annual rate of increase of more than 1.56 per cent per year. During the period under reference, China was able to achieve an advanced stage of population transition whereas India continues to stuck up in the middle of the population transition path. During 2017-17, China's population is estimated to have increased by less than 0.5 per cent thanks to its very stringent population control policy popularly known as the one-child policy. By comparison, the population growth during 2017-18 in India was estimated to more than twice as rapid as than in China. During 2017-18, less than 7 million people were estimated to have been added to the population of China. This number was almost 16 million during 1990-91 which suggests that China has been able to cut rapidly the net annual addition to the population during the period under reference. In India, by contrast, almost 14 million people were added to country's population during 2017-18 as compared to more than 18 million during 1990-91 which indicates that the reduction in the annual net addition to the population in India has not been very significant during the period under reference.

The change in the population age composition in China during the period under reference has been very marked as compared to the change in population age composition in India. The proportion of the working age (15-59 years) population to the total population in China increased from almost 63 per cent in 1990 to an all

7

time high of almost 70 per cent in 2007 but then decreased to less than 66 per cent in 2018. This indicates that the demographic dividend resulting from the change in population age composition fuelled economic growth in the country up to the year 2007 but turned negative after 2007. In India, the proportion of working age population to total population increased consistently from almost 56 per cent in 1990 to slightly more than 63 per cent in 2018 indicating that the demographic dividend resulting from the change in the population age composition in India always contributed to accelerating economic growth but the magnitude of the contribution has always been very small. The proportion of working age population to total population in India in 2018 was almost the same as the proportion in China way back in 1990 which indicates that India lagged behind China in population transition during the period under reference. If the increase in the proportion of working age population to the total population in India during 1990 through 2018 is any indication, then, there is little possibility of any substantial increase in the demographic dividend in the country. The demographic dividend in India will remain small in terms of magnitude, although the period of demographic dividend in India may last longer than that in China.

Productivity of Economic System in China and India

In 1990, the labour productivity, measured as the ratio of real total output to the total labour force was higher in India as compared to China (Figure 3). However, during the period under reference, labour productivity increased very rapidly in China from just 1245 2010 US $ per labour in 1990 to more than 13445 2010 US $ per labour in 2018 which implies that the labour productivity in the countries increased by around 11 times in the country during the period under reference. This rapid increase in the labour productivity in China indicates that the country has been able to modernisation its social and economic production system in a big way during the period under reference through capital investment and technology up-gradation and innovation. By comparison, the process of modernisation of the social and economic system in India has been relatively slow as the labour productivity in India could increase from around 1603 2010 US $ per labour in 1990 to only 5827 2010 US $ per labour in 2018 which means that the labour productivity in India increased by only around 4 times only during the period under reference. It appears that India could not modernise its social and economic production system in the similar manner as China was able to do during the period under reference. If the labour productivity reflects the modernisation of the social and economic production system, then it is obvious from figure 3 that India lagged behind China substantially in terms of capita investment and technology up-gradation and innovation of the social and economic production system during the period under reference.

At the same time, there has also been a big difference between the two countries in terms of the opportunities of participation in the social and economic production system for the working age population. In China, the labour force constituted almost 90 per cent of the working age population in 1990 compared to less than 65 per cent in India. In both countries, however, the ratio of the labour force to the working age population decreased during the period under reference.

However, the decrease in this ratio has been more rapid in India as compared to that in China. The ratio of labour force to the working age population in India decreased by 8 percentage points, from almost 65 per cent in 1990 to less than 57 per cent in 2018 over a period of 28 years as compared to the decrease of only 4 percentage points in China. In other words, China was able to generate additional participation opportunities in its social and economic production system so that there has been only a marginal decrease in the ratio of the labour force to the working age population of the country. In India, additional participation opportunities created in the social and economic production system appear to have fallen significantly short of the demand for participation so that the participation opportunities in the social and economic production system of the country decreased substantially. It appears that because of relatively slow modernisation, the social and economic production system in India could generate only limited additional opportunities for the participation of ever increasing working age population in the social and economic production system of the country. India, thus, lagged behind China in terms of both productivity of the labour force as well as the opportunities of participation for the working age population in the social and economic production system.

Decomposition Analysis

The rapid expansion of the economy of China during 1990-2018, as reflected by the rapid growth of the real total output, has primarily been the result of the rapid increase in the labour productivity in the country. The increase in the labour productivity in China during the period under reference accounted for almost 93 per cent of the increase in the real total output of the country. By comparison, the increase in population accounted for only about 7.5 per cent of the increase, the change in the ratio of the working age population to the total population accounted for just 1.7 per cent of the growth in the real total output during the period under reference. On the other hand, the decrease in the ration of the labour force to the working age population or the participation opportunity during the period under reference resulted in a decrease of around 1.9 per cent in the growth of the real total output of the country during the period under reference. The decomposition analysis suggests that the labour productivity has been the sole driver of the expansion and growth of China's economy since 1990.

The relative contribution of the increase in population, demographic dividend, increase in labour productivity and change in participation opportunity to the growth of the real total output in India has been different in India. The increase in labour productivity in India accounted for only about three-fourth of the growth in the real total output of the country during the period under reference; another one fourth of the growth in the real total output was accounted by the increase in population while the contribution of the demographic dividend was around 7 per cent only. Finally, the decrease in the opportunity of participation in the social and economic production system over time contributed a decrease of around 7 per cent in real total output of the country. In other words, the demographic component of the growth of economy has been quite substantial in India but only marginal in China during the period under reference.

In absolute terms, China's economy expanded by more than 9969 billion 2010 US $ between 1990 and 2018. The increase in the population resulted in an increase of almost 750 billion 210 US $ while the transition in the age composition of the population resulted in an increase of almost 170 billion 2010 US $. On the other hand, the increase in labour productivity led to an increase of almost 9238 billion 2010 US $ while the decrease in the participation opportunity accounted for a decrease of almost 188 billion 2010 US $ to the economy of the country during 1990 through 2018. India's economy, by contrast, expanded by only around 2334 billion 2010 US $ during this period as the result of an increase of almost 593 billion 2010 US $ due to the growth of the population; an increase of around 168 billion 2010 US $ as the result of the demographic dividend; an increase of almost 1749 billion as the result of the increase in labour productivity; and a decrease of around 176 billion 2010 US $ as the result of the decrease in the participation opportunity. This means that the demographic component accounted for only around 920 billion of the 9969 billion 2010 US $ growth (9 per cent) of China's economy during 1990-2018. By comparison, the demographic component accounted for around 761 billion of the 2334 billion 2010 US $ (33 per cent) growth of India's economy. This implies that more than 90 per cent of the economic growth in China during 1990-2018 contributed to improving the standard of living of Chinese people whereas only about two-third of the economic growth in India contributed to improving the standard of living of the Indian people during this period. The impact of the economic growth on the quality of the life of the people of India has been significantly smaller than the impact of the economic growth on the quality of life of the people of China because the main drivers of economic growth in China and India, during the period under reference, have essentially been different.

In both countries, the relative contribution of the four factors to the growth of the economy has been different in different years of the reference period. The contribution of the demographic component has always been smaller than that of the economic component in China. The demographic dividend, resulting from the increase in the ratio of the working age population to the total population contributed very substantially to the growth of the economy in China during the period 2000 through 2004. However, after 2007, this ratio started decreasing so that the demographic dividend in the country turned negative. The increase in the ratio of the working age population to the total population in the country during 2000-2004 was, however, associated with a decrease in the ratio of the labour force to the working age population. As a result, the positive contribution of the change in the population age composition to the growth of the economy was largely compensated by the negative contribution of the decrease in participation opportunity of the working age population.

In India, on the other hand, demographic factors have been more dominant in shaping the growth of the economy than China. Unlike China, the share of the demographic component has been larger than the share of the economic component in the growth of India's economy during the years 1997, 2000, 2002 and 2008. During the year 2000 and again during the year 2008, the demographic component accounted for more than 63 per cent of the growth in the economy of the country. The share of the demographic component in economic growth during the year 2000 was larger than the share of the economic component primarily because of very

large demographic dividend By contrast, the share of the demographic component was larger than the share of the economic component in the growth of the economy during the year 2008 primarily because a very substantial decrease in the opportunity of participation of the working age population in the productive activities.

Finally, the difference in the rate of growth in the real output between the two countries can be decomposed into the difference in the population growth rate, difference in the demographic dividend, difference in the rate of increase in the labour productivity and the difference in the rate of change in the participation opportunity. Between 1990 and 2018, the real output of China increased at an average annual rate of 9.173 per cent per year whereas India's real output increased at an average annual rate of 6.152 per cent per year. This difference in the rate of growth of the two economies has been the result of the difference in population growth rate (-0.873 per cent per year), the difference in the demographic dividend (-0.287 per cent per year), the difference in the rate of increase in labour productivity (3.891 per cent per year), and the difference in the rate of change in participation opportunity (0.290 per cent per year). In other words, the economic component contributed to an increase the disparity in the growth of the economy of the two countries whereas the demographic component contributed to the decrease in the disparity in economic growth between the two countries. The primary driver of increasing disparity in economic growth between the two countries has however been the increasing disparity in the labour productivity. Moreover, the disparity in the annual growth of the economy of the two countries varied widely in different years of the period under reference. Since 2014, the annual growth of India's economy has been faster than the annual growth of China's economy mainly because of relatively faster growth of the demographic component of the economy in India as compared to China. At the same time, the difference in the growth of the economic component between the two countries narrowed down after 2014. The increase in labour productivity in China was slower than that in India during 2015-16 whereas the difference in the annual increase in the participation opportunity also narrowed down.

The increase in the disparity in the size of the economy of the two countries during the period under reference has, however, been more consistent. In 1990, the demographic component of the economy accounted for 85 per cent of the different in the size of the economy of the two countries. By contrast, in 2018, the demographic component accounted for only 7 per cent of the difference in the size of the economy of the two countries. More specifically, the contribution of the difference in the population size decreased from 61 per cent in 1990 to only 4 per cent in 2018 because the difference in the population of the two countries narrowed down during the period under reference because population of China increased slowly compared to the increase in population of India. At the same time, the contribution of the difference in the ratio of the working age population to the total population decreased from 24 per cent to only 3 per cent during this period. On the other hand, the labour productivity in India was higher than that of China during 1990-1992 but, by 2018, the difference in the labour productivity between the two countries accounted for 63 per cent of the difference in the size of the economy of the two countries. Finally, the contribution of the difference in the participation

11

opportunity decreased from 63 per cent in 1990 to 31 per cent in 2018. In 1990, the difference in the size of the economy of the two countries was almost entirely because of the demographic differences but by 2018, the difference in the size of the two economies was almost entirely because of the difference in the economic component.

Discussions and Conclusions

The analysis presented in the foregoing pages suggests that around one third of the economic growth in India during 1990-2018 may be attributed to demographic factors and, therefore, contributes little to improving the quality of life of the Indian people. This has not been the case in China where, more than 90 per cent of the growth in the economy during the period under reference was due to economic factors - labour productivity and opportunity of participation of the working age population in productive activities. This implies that the impact of the economic growth on the quality of life of the people has been substantially stronger in China than in India. In other words, the composition of economic growth or the relative contribution of demographic and economic factors to economic growth has also contributed to increasing the disparities in the standard of living or quality of life of the people of the two countries. China has been able to increase the labour productivity very significantly through investment in human development. In terms of the human development index (HDI), China ranks 85 among the 189 countries of the world with an HDI of 0.758 whereas India ranks a poor 129 with an HDI of 0.647 (United Nations, 2019a). The expectation of life at birth in China is almost 77 years compared to less than 70 years in India. The expected years of schooling in China is almost 14 years compared to less than 12 years in India. Similarly, the mean years of schooling in China is almost 8 years compared to less than 7 years in India according to the latest Human Development Report prepared by the United Nations. India lags way behind China in terms of human development and this disparity in human development between the two countries has reflection in the disparity in labour productivity.

China has also been able to create near sufficient opportunities for participation of the working age population in productive activities and one factor in high participation opportunity in China has been the advanced stage of population transition that the country has achieved. The proportion of the working age population to the total population is decreasing in China for quite some times so that the number of person seeking participation in productive activities has decreased. In India, by contrast, the demand for participation in productive activities is increasing as the proportion of working age population to the total population continues to increase in the country. However, the social and economic production system of the country has been able to provide opportunities of participation to only a proportion of the ever increasing working age population and this proportion is decreasing at a faster rate as compared to the decrease in China. The decrease in the participation opportunity in either China or India is actually a reflection of the capital oriented, technology driven approach to modernising the social and economic production system that currently rules the world. However, compared to China, the decrease in the opportunity of participation in the social and

economic production system in India, as measured through the ratio of the labour force to the working age population appears alarming in the context of both economic growth and standard of living. Reversing the decreasing trend in the participation opportunity in India may contribute significantly towards accelerating economic growth in the country. This is possible through restructuring the social and economic production system of the country.

It is also evident from the present analysis that economic growth in China has now become virtually independent of demographic factors and is driven primarily by economic factors - labour productivity and participation opportunity. The key to economic progress in China, therefore, lies in continued increase in labour productivity and identifying new avenues of participation in social and economic production system. China is now at an advanced stage of demographic transition and the demographic dividend has turned negative. The level of fertility in the country continues to be well below the replacement level and the average life of a Chinese national is nearing 80 years. As a result, the proportion of the old population in China is bound to increase rapidly in the coming years. In such a scenario, the country must explore possibilities of productive utilisation of the old population to sustain economic growth. Productive utilisation of the old population is essential for China to reverse the decreasing trend in the growth of the economy that the country has witnessed in the recent past. Productive utilisation of the old people roles may also be a crucial factor for improved health and well-being of the old people (Rowe and Kahn, 1997; Morrow-Howell et al, 2005; Hinterlong, 2008).

In India, the challenge of economic growth essentially lies in its economic system as economic growth that actually contributes to improving the standard of living remains low. India needs to take immediate steps to halt the rapid decrease in opportunities of participation in the social and economic production system by creating new avenues of participation within the economy. The rapid decrease in the participation opportunities suggests that country's economy remains traditional and not in sync with other dimensions of development. For example, in the rural economy of the country, there is little opportunity of participation for educated females as there is little productive activity in villages other than agriculture (Chaurasia, 2020; pp 217). Promotion of home-based productive activities in villages may facilitate participation of literate females in productive processes (Sanghi et al, 2015) and contribute to increasing the labour productivity which is low compared to China. India also needs to reinvigorate its population transition efforts so as to lessen the dependence of economic growth on demographic factors which, essentially, do not contribute to improving the quality of life of the people. The country is yet to achieve the replacement fertility and, even if the replacement fertility is achieved, the population of the country will continue to increase for at least 30-40 years because of the momentum for growth built-in in the age structure of the population. This increase in population will fuel economic growth but such a growth will hardly contribute to improving the standard of living. Moreover, the growth in population will put additional pressure on the economy to create additional opportunities of participation for the increasing working age population. There is, unfortunately, no way of curtailing population growth attributed to the momentum built-in in the age structure of the population as this momentum is the result of the past trends in fertility and mortality.

References

Ang BW (2016) A simple guide to LMDI decomposition analysis. Singapore, National University of Singapore, Department of Industrial and Systems Engineering.

Birdsall N, Kelley A, Sinding S (2001) *Population Matters: Demography, Growth, and Poverty in the Developing World*. Oxford University Press.

Bloom DE (2011) Population dynamics in India and implications for economic growth. Program on the Demography of Global Aging. Harvard University. PGDA Working Paper No. 65

Bloom DE, Canning D, Hu L, Liu Y, Mahal A, Yip W (2006) Why has China's economy taken off faster than India's.

Bloom DE, Canning D, Sevilla J (2003) The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change. Santa Monica: RAND. MR-1274.

Bloom DE, Canning D, Sevilla J (2001) Economic growth and the demographic transition. Cambridge, National Bureau of Economic Research. Working Paper No. 8685.

Bloom DE, Finlay JE (2008) Demographic change and economic growth in Asia. Program on the Demography of Global Aging. Harvard University.

Bloom DE, Williamson JG (1998) Demographic transition and economic miracles in emerging Asia. *World Bank Economic Review* 12:419-455.

Chaurasia AR (2020) *Population and Sustainable Development in India*. Singapore, Springer Nature.

Choudhry MT, Elhorst JP (2010) Demographic transition and economic growth in China, India and Pakistan. *Economic System* 24(3): 218-236.

Golley J, Tyers R (2011) Contrasting giants: demographic change and economic performance in China and India. Australian National University. Centre for Applied Macroeconomic Analysis.

Golley J, Tyres R (2013) Contrasting giants: demographic change and economic performance in China and India. *Procedia - Social and Behavioral Sciences* 77: 353-383.

Hinterlong JE (2008) Productive engagement among older Americans: prevalence, patterns, and implications for public policy. *Journal of Aging and Social Policy* 20: 141–164.

International Labour Organization. (2020). ILOSTAT database [database]. Available from https://ilostat.ilo.org/data/.

Joe W, Dash AK, Agrawal P (2015) Demographic transition, savings, and economic growth in China and India. New Delhi, Institute of Economic Growth. Working Paper No. 351.

Kelley A (2001) The population debate in historical perspective: revisionism revised. In N Birdsall, A Kelley, S Sinding (eds) *Population Matters: Demography, Growth, and Poverty in the Developing World.* pp. 24-54. Oxford University Press.

Lee R, Mason A (2006) What is demographic dividend? *Finance and Development* 30(3).

Lee R, Mason A, Miller T (2000). Life-cycle saving and the demographic transition in Eastern and South-Eastern Asia. *Population and Development Review* 26 (supplement):

Mason A (2005) Demographic transition and demographic dividends in developed and developing countries. Paper presented at United Nations Expert Group Meeting on Social and Economic Implications of Changing Population Age Structures, Mexico City.

Mason A, Lee R, Lee S-H (2008) The demographic transition and economic growth in the Pacific Rim. Paper prepared for the East Asian Seminar on Economics (EASE), held in Seoul, Korea, June 19-21, 2008.

Morrow-Howell N, Tang F, Kim ML, Sherraden M (2005) Maximizing the productive engagement of older adults. In: ML Wykle, PJ Whitehouse, DL Morris (eds) *Successful Aging Through the Life Span: Intergenerational Issues in Health*. New York: Springer: 19–54.

Piketty T (2014) *Capital in the Twenty-First Century*. Cambridge, The Belknap Press of Harvard University Press.

Prskawetz A, Fent T, Barthel W, Crespo-Cuaresma J, Lindh T, Malmbergh B, Halvarsson M (2007) The relationship between demographic change and economic growth in the EU. European Commission, Employment, Social Affairs and Equal Opportunities DG. Research Report No. 32

Ranganathan S, Swain RB, Sumpter DJT (2015) The demographic transition and economic growth: implications for development policy. *Palgrave Communication.* DOI:10.1057/palcomms.2015.33.

Rowe JW, Kahn RL (1997) Successful aging. *Gerontologist* 37: 433-440.

Sanghi S, Sirja A, Vijay SS (2015) Decline in rural female labour force participation in India. A relook into causes. *Vikalp. Journal of Decision Makers* 40(3): 255-268.

United Nations (2019) *World Population Prospects 2019, Online Edition. Rev. 1*. New York, Department of Economic and Social Affairs, Population Division.

United Nations (2019a) *Human Development Report 2019. Beyond income, beyond averages, beyond today: Inequalities in Human Development in the 21st Century*. New York, United Nations Development Program.

Wang X, Chen K, Huang Z (2013) The impact of China's demographic transition on economic growth and income distribution: CGE modeling with top-down micro-simulation. Paper presented at Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.

Wolf Jr C, Dalal S, DaVanzo J, Larson EV, Akhmedjonov A, Dogo H, Huang M, Montoya S (2011) *China and India, 2025. A Comparative Assessment*. Santa Monica, Rand Corporation.

Table 1
Total output, population, working age population and labour force min China and India, 1990-2018

Year	Total output (Billion 2010 US $)		Population (Million)		Working age population (15-59 years) (Million)		Labour force (Million)	
	China	India	China	India	China	India	China	India
1990	827.732	507.565	1176.884	873.278	740.48	488.398	665.09	316.561
1991	904.662	512.929	1192.897	891.273	749.857	499.647	673.818	323.814
1992	1033.271	541.050	1206.711	909.307	760.872	511.204	684.458	331.388
1993	1176.560	566.754	1218.817	927.404	772.255	523.149	695.649	339.358
1994	1330.127	604.494	1230.020	945.602	782.307	535.628	705.468	347.851
1995	1475.765	650.281	1240.921	963.923	790.531	548.688	713.152	355.752
1996	1622.285	699.374	1251.636	982.365	803.668	561.477	724.750	363.470
1997	1772.034	727.698	1261.996	1000.9	812.309	574.796	731.828	371.462
1998	1910.919	772.701	1271.982	1019.484	819.187	588.597	736.673	379.712
1999	2057.439	841.053	1281.515	1038.058	828.267	602.794	742.621	388.183
2000	2232.146	873.357	1290.551	1056.576	841.179	617.293	751.011	396.839
2001	2418.305	915.488	1299.130	1075.000	852.850	631.125	754.720	406.742
2002	2639.112	950.313	1307.352	1093.317	868.789	645.331	760.789	416.973
2003	2903.963	1025.011	1315.304	1111.523	886.923	659.783	768.073	427.475
2004	3197.589	1106.222	1323.085	1129.623	903.527	674.338	774.598	438.182
2005	3561.979	1193.873	1330.776	1147.610	916.568	688.895	779.562	449.054
2006	4015.045	1290.108	1338.409	1165.486	927.461	702.846	784.130	451.551
2007	4586.441	1388.940	1345.994	1183.209	935.372	716.833	787.819	454.038

Year	Total output (Billion 2010 US $)		Population (Million)		Working age population (15-59 years) (Million)		Labour force (Million)	
	China	India	China	India	China	India	China	India
2008	5029.229	1431.813	1353.569	1200.670	940.536	730.735	790.497	456.497
2009	5501.968	1544.380	1361.169	1217.726	944.010	744.481	792.343	458.947
2010	6087.165	1675.615	1368.811	1234.281	946.390	758.033	793.375	461.401
2011	6668.544	1763.440	1376.498	1250.288	946.975	770.622	796.628	462.069
2012	7192.667	1859.660	1384.206	1265.780	946.225	783.289	799.638	462.943
2013	7751.438	1978.420	1391.883	1280.842	944.656	795.958	802.102	467.577
2014	8317.255	2125.025	1399.454	1295.601	942.932	808.475	803.897	472.075
2015	8891.588	2294.947	1406.848	1310.152	941.492	820.757	804.985	476.338
2016	9490.586	2482.434	1414.049	1324.517	940.143	833.2	805.101	480.526
2017	10131.865	2660.372	1421.022	1338.677	939.287	844.996	804.439	484.234
2018	10797.222	2841.58	1427.648	1352.642	938.47	856.41	803.071	487.636

Source: Estimates of the total output have been taken from the World Bank database.

Estimates of population and working age population are taken from United Nations (2019).

Estimates of labour force are model estimates prepared by International Labour Organization.

Table 2

Ratio of working age population to total population, labour productivity and ratio of labour force to working age population in China and India, 1990-2018.

Year	Ratio of working age population to total population		Labour productivity (Output per labour)		Ratio of labour force to working age population	
	China	India	China	India	China	India
1990	0.6292	0.5593	1245	1603	0.8982	0.6482
1991	0.6286	0.5606	1343	1584	0.8986	0.6481
1992	0.6305	0.5622	1510	1633	0.8996	0.6483
1993	0.6336	0.5641	1691	1670	0.9008	0.6487
1994	0.6360	0.5664	1885	1738	0.9018	0.6494
1995	0.6371	0.5692	2069	1828	0.9021	0.6484
1996	0.6421	0.5716	2238	1924	0.9018	0.6473
1997	0.6437	0.5743	2421	1959	0.9009	0.6463
1998	0.6440	0.5773	2594	2035	0.8993	0.6451
1999	0.6463	0.5807	2771	2167	0.8966	0.644
2000	0.6518	0.5842	2972	2201	0.8928	0.6429
2001	0.6565	0.5871	3204	2251	0.8849	0.6445
2002	0.6645	0.5903	3469	2279	0.8757	0.6461
2003	0.6743	0.5936	3781	2398	0.8660	0.6479
2004	0.6829	0.5970	4128	2525	0.8573	0.6498
2005	0.6887	0.6003	4569	2659	0.8505	0.6518
2006	0.6930	0.6030	5120	2857	0.8455	0.6425
2007	0.6949	0.6058	5822	3059	0.8423	0.6334

Year	Ratio of working age population to total population		Labour productivity (Output per labour)		Ratio of labour force to working age population	
	China	India	China	India	China	India
2008	0.6949	0.6086	6362	3137	0.8405	0.6247
2009	0.6935	0.6114	6944	3365	0.8393	0.6165
2010	0.6914	0.6141	7672	3632	0.8383	0.6087
2011	0.6880	0.6164	8371	3816	0.8412	0.5996
2012	0.6836	0.6188	8995	4017	0.8451	0.5910
2013	0.6787	0.6214	9664	4231	0.8491	0.5874
2014	0.6738	0.6240	10346	4501	0.8526	0.5839
2015	0.6692	0.6265	11046	4818	0.8550	0.5804
2016	0.6649	0.6291	11788	5166	0.8564	0.5767
2017	0.6610	0.6312	12595	5494	0.8564	0.5731
2018	0.6574	0.6331	13445	5827	0.8557	0.5694

Source: Author's calculations based on table 1.

Table 3
Decomposition of the annual growth of the real output of the economy of China, 1990-2018

Period	Growth of total output (Per cent)	Population growth rate (Per cent)	Change in the ratio of working age population to total population (Per cent)	Increase in labour productivity (Per cent)	Rate of change in participation opportunity (Per cent)	Growth of total output attributed to change in demographic component (Per cent)	Growth of total output attributed to change in economic component (Per cent)
1990-91	8.887	1.352	-0.093	7.583	0.045	1.258	7.629
1991-92	13.292	1.151	0.307	11.726	0.108	1.458	11.834
1992-93	12.987	0.998	0.487	11.365	0.137	1.485	11.502
1993-94	12.268	0.915	0.378	10.866	0.108	1.293	10.975
1994-95	10.390	0.882	0.163	9.307	0.038	1.046	9.345
1995-96	9.466	0.860	0.788	7.853	-0.035	1.648	7.818
1996-97	8.829	0.824	0.245	7.857	-0.098	1.069	7.760
1997-98	7.546	0.788	0.055	6.886	-0.183	0.843	6.702
1998-99	7.388	0.747	0.356	6.584	-0.298	1.102	6.285
1999-2000	8.150	0.703	0.844	7.027	-0.423	1.547	6.603
2000-01	8.010	0.663	0.715	7.518	-0.885	1.378	6.632
2001-02	8.738	0.631	1.221	7.937	-1.051	1.852	6.886
2002-03	9.563	0.606	1.459	8.611	-1.113	2.066	7.498
2003-04	9.632	0.590	1.265	8.786	-1.009	1.855	7.777
2004-05	10.792	0.580	0.853	10.153	-0.794	1.433	9.359
2005-06	11.973	0.572	0.610	11.389	-0.597	1.181	10.792

Period	Growth of total output (Per cent)	Population growth rate (Per cent)	Change in the ratio of working age population to total population (Per cent)	Increase in labour productivity (Per cent)	Rate of change in participation opportunity (Per cent)	Growth of total output attributed to change in demographic component (Per cent)	Growth of total output attributed to change in economic component (Per cent)
2006-07	13.306	0.565	0.284	12.836	-0.380	0.849	12.456
2007-08	9.216	0.561	-0.011	8.877	-0.211	0.551	8.666
2008-09	8.984	0.560	-0.191	8.751	-0.135	0.369	8.615
2009-10	10.108	0.560	-0.308	9.978	-0.122	0.252	9.856
2010-11	9.122	0.560	-0.498	8.713	0.347	0.062	9.060
2011-12	7.566	0.558	-0.638	7.189	0.456	-0.079	7.645
2012-13	7.482	0.553	-0.719	7.174	0.474	-0.166	7.648
2013-14	7.045	0.542	-0.725	6.822	0.406	-0.183	7.228
2014-15	6.677	0.527	-0.680	6.542	0.288	-0.153	6.830
2015-16	6.519	0.511	-0.654	6.505	0.158	-0.143	6.663
2016-17	6.539	0.492	-0.583	6.621	0.009	-0.091	6.630
2017-18	6.360	0.465	-0.552	6.531	-0.083	-0.087	6.447
1990-2018*	9.173	0.69	0.156	8.499	-0.173	0.846	8.326

Source: Author's calculations
Remarks   * Average annual growth rate during the period

Table 4
Decomposition of the annual growth of the real output of the economy of India, 1990-2018

Period	Growth of total output (Per cent)	Population growth rate (Per cent)	Change in the ratio of working age population to total population (Per cent)	Increase in labour productivity (Per cent)	Rate of change in participation opportunity (Per cent)	Growth of total output attributed to change in demographic component (Per cent)	Growth of total output attributed to change in economic component (Per cent)
1990-91	1.051	2.040	0.237	-1.214	-0.012	2.277	-1.226
1991-92	5.337	2.003	0.284	3.025	0.025	2.287	3.051
1992-93	4.641	1.971	0.339	2.265	0.067	2.310	2.331
1993-94	6.447	1.943	0.414	3.975	0.115	2.357	4.089
1994-95	7.301	1.919	0.490	5.055	-0.163	2.409	4.892
1995-96	7.278	1.895	0.409	5.132	-0.158	2.304	4.974
1996-97	3.970	1.869	0.475	1.795	-0.169	2.344	1.626
1997-98	6.001	1.840	0.533	3.804	-0.176	2.373	3.628
1998-99	8.476	1.806	0.578	6.270	-0.177	2.383	6.093
1999-2000	3.769	1.768	0.609	1.564	-0.171	2.377	1.392
2000-01	4.711	1.729	0.487	2.246	0.249	2.216	2.495
2001-02	3.733	1.690	0.536	1.249	0.258	2.226	1.507
2002-03	7.567	1.651	0.563	5.079	0.273	2.215	5.352
2003-04	7.625	1.615	0.567	5.151	0.292	2.182	5.443
2004-05	7.625	1.580	0.556	5.174	0.315	2.136	5.489
2005-06	7.752	1.546	0.459	7.198	-1.450	2.005	5.747

Period	Growth of total output (Per cent)	Population growth rate (Per cent)	Change in the ratio of working age population to total population (Per cent)	Increase in labour productivity (Per cent)	Rate of change in participation opportunity (Per cent)	Growth of total output attributed to change in demographic component (Per cent)	Growth of total output attributed to change in economic component (Per cent)
2006-07	7.382	1.509	0.461	6.832	-1.421	1.970	5.411
2007-08	3.040	1.465	0.456	2.500	-1.381	1.921	1.119
2008-09	7.568	1.411	0.453	7.033	-1.328	1.864	5.705
2009-10	8.156	1.350	0.454	7.623	-1.271	1.804	6.352
2010-11	5.109	1.289	0.359	4.964	-1.502	1.647	3.462
2011-12	5.313	1.231	0.399	5.124	-1.441	1.630	3.682
2012-13	6.190	1.183	0.421	5.194	-0.608	1.604	4.586
2013-14	7.149	1.146	0.415	6.191	-0.603	1.560	5.588
2014-15	7.693	1.117	0.391	6.794	-0.609	1.508	6.185
2015-16	7.853	1.090	0.414	6.978	-0.629	1.505	6.348
2016-17	6.923	1.063	0.343	6.154	-0.637	1.406	5.517
2017-18	6.589	1.038	0.304	5.889	-0.642	1.342	5.248
1990-2018*	6.152	1.563	0.443	4.609	-0.463	2.006	4.146

Source: Author's calculations

Remarks * Average annual growth rate during the period.

Table 5
Decomposition of the annual increase in the real output of China, 1990-2018

Period	Increase in total output (Billion 2010 US $)	Increase in the total output due to					
		Population growth	Demographic dividend	Increase in labour productivity	Change in participation opportunity	Change in demographic component	Change in economic component
1990-91	76.93	11.699	-0.806	65.644	0.393	10.893	66.037
1991-92	128.608	11.140	2.970	113.451	1.048	14.109	114.499
1992-93	143.290	11.014	5.371	125.395	1.510	16.384	126.905
1993-94	153.566	11.453	4.735	136.022	1.356	16.189	137.378
1994-95	145.639	12.367	2.290	130.454	0.527	14.657	130.981
1995-96	146.519	13.309	12.203	121.548	-0.540	25.511	121.008
1996-97	149.749	13.981	4.158	133.267	-1.655	18.138	131.611
1997-98	138.885	14.508	1.012	126.738	-3.373	15.519	123.366
1998-99	146.519	14.808	7.056	130.573	-5.917	21.863	124.656
1999-2000	174.708	15.061	18.097	150.624	-9.075	33.159	141.549
2000-01	186.159	15.398	16.625	174.710	-20.574	32.022	154.137
2001-02	220.807	15.944	30.848	200.565	-26.551	46.792	174.015
2002-03	264.851	16.793	40.418	238.465	-30.825	57.211	207.640
2003-04	293.626	17.981	38.561	267.836	-30.752	56.542	237.084
2004-05	364.390	19.572	28.816	342.820	-26.818	48.388	316.002
2005-06	453.065	21.640	23.065	430.958	-22.598	44.705	408.360
2006-07	571.397	24.269	12.203	551.241	-16.317	36.473	534.924
2007-08	442.788	26.965	-0.511	426.483	-10.149	26.454	416.334

| Period | Increase in total output (Billion 2010 US $) | Increase in the total output due to | | | | | |
		Population growth	Demographic dividend	Increase in labour productivity	Change in participation opportunity	Change in demographic component	Change in economic component
2008-09	472.738	29.462	-10.062	460.463	-7.126	19.401	453.337
2009-10	585.197	32.410	-17.835	577.664	-7.042	14.575	570.622
2010-11	581.380	35.692	-31.750	555.299	22.139	3.942	577.438
2011-12	524.123	38.687	-44.175	497.998	31.613	-5.489	529.612
2012-13	558.771	41.307	-53.704	535.793	35.375	-12.397	571.168
2013-14	565.818	43.563	-58.233	547.869	32.618	-14.670	580.487
2014-15	574.333	45.324	-58.470	562.694	24.785	-13.146	587.479
2015-16	598.997	46.911	-60.082	597.674	14.493	-13.170	612.168
2016-17	641.280	48.241	-57.183	649.351	0.870	-8.941	650.221
2017-18	665.357	48.665	-57.759	683.164	-8.712	-9.094	674.451
1990-2018	9969.490	749.775	169.994	9237.718	-187.997	919.769	9049.721

Source: Author's calculations

Table 6

Decomposition of the annual increase in the real output of India, 1990-2018

Period	Increase in total output (Billion 2010 US $)	Increase in the total output due to					
		Population growth	Demographic dividend	Increase in labour productivity	Change in participation opportunity	Change in demographic component	Change in economic component
1990-91	5.364	10.408	1.211	-6.196	-0.059	11.619	-6.254
1991-92	28.121	10.554	1.494	15.939	0.134	12.048	16.073
1992-93	25.704	10.913	1.879	12.543	0.369	12.792	12.912
1993-94	37.740	11.376	2.423	23.269	0.671	13.800	23.940
1994-95	45.787	12.034	3.074	31.702	-1.022	15.108	30.680
1995-96	49.093	12.784	2.758	34.617	-1.065	15.542	33.551
1996-97	28.323	13.335	3.390	12.806	-1.208	16.726	11.598
1997-98	45.004	13.797	3.998	28.530	-1.321	17.795	27.209
1998-99	68.351	14.560	4.659	50.558	-1.426	19.219	49.132
1999-2000	32.305	15.155	5.217	13.402	-1.470	20.372	11.933
2000-01	42.130	15.460	4.357	20.089	2.225	19.816	22.314
2001-02	34.825	15.760	5.004	11.651	2.410	20.764	14.061
2002-03	74.698	16.303	5.561	50.142	2.691	21.865	52.833
2003-04	81.211	17.205	6.036	54.861	3.109	23.241	57.970
2004-05	87.651	18.159	6.391	59.478	3.623	24.550	63.101
2005-06	96.235	19.188	5.700	89.351	-18.004	24.888	71.347
2006-07	98.833	20.207	6.176	91.480	-19.030	26.383	72.450
2007-08	42.872	20.659	6.430	35.254	-19.471	27.089	15.784

Period	Increase in total output (Billion 2010 US $)	Increase in the total output due to						
		Population growth	Demographic dividend	Increase in labour productivity	Change in participation opportunity	Change in demographic component	Change in economic component
2008-09	112.568	20.981	6.738	104.608	-19.758	27.719	84.849
2009-10	131.235	21.728	7.301	122.654	-20.449	29.029	102.206
2010-11	87.825	22.152	6.164	85.336	-25.827	28.316	59.509
2011-12	96.220	22.304	7.225	92.797	-26.106	29.529	66.691
2012-13	118.760	22.693	8.086	99.652	-11.671	30.779	87.981
2013-14	146.605	23.496	8.505	126.974	-12.369	32.001	114.605
2014-15	169.922	24.671	8.632	150.062	-13.443	33.303	136.619
2015-16	187.486	26.034	9.890	166.587	-15.024	35.924	151.562
2016-17	177.938	27.332	8.804	158.183	-16.380	36.136	141.802
2017-18	181.208	28.540	8.358	161.957	-17.648	36.898	144.310
1990-2018	2334.015	592.906	168.101	1748.572	-175.564	761.007	1573.008

Source: Author's calculations

Table 7
Decomposition of the difference in the annual growth of real output between China and India, 1990-2018.

Period	Difference in annual growth (per cent) in total output of China and India	Difference in the total output attributed to the difference in					
		Population size	Demographic dividend	Labour productivity	Participation opportunity	Demographic component	Economic component
1990-91	7.836	-0.688	-0.330	8.798	0.057	-1.019	8.855
1991-92	7.955	-0.852	0.023	8.700	0.083	-0.828	8.783
1992-93	8.345	-0.972	0.147	9.100	0.070	-0.825	9.170
1993-94	5.821	-1.028	-0.036	6.892	-0.006	-1.064	6.885
1994-95	3.089	-1.037	-0.327	4.252	0.201	-1.363	4.452
1995-96	2.188	-1.035	0.379	2.721	0.123	-0.656	2.844
1996-97	4.859	-1.045	-0.230	6.063	0.072	-1.275	6.134
1997-98	1.545	-1.051	-0.478	3.082	-0.007	-1.530	3.074
1998-99	-1.088	-1.059	-0.222	0.314	-0.122	-1.281	0.193
1999-2000	4.381	-1.066	0.236	5.463	-0.252	-0.830	5.211
2000-01	3.299	-1.066	0.228	5.271	-1.134	-0.838	4.137
2001-02	5.004	-1.059	0.684	6.687	-1.309	-0.374	5.379
2002-03	1.997	-1.045	0.896	3.531	-1.386	-0.149	2.146
2003-04	2.007	-1.025	0.698	3.635	-1.301	-0.327	2.335
2004-05	3.167	-1.000	0.297	4.979	-1.109	-0.703	3.869
2005-06	4.221	-0.974	0.150	4.191	0.853	-0.823	5.044
2006-07	5.924	-0.944	-0.177	6.004	1.041	-1.121	7.045
2007-08	6.176	-0.904	-0.467	6.377	1.169	-1.370	7.546

Period	Difference in annual growth (per cent) in total output of China and India	Difference in the total output attributed to the difference in					
		Population size	Demographic dividend	Labour productivity	Participation opportunity	Demographic component	Economic component
2008-09	1.416	-0.851	-0.644	1.718	1.193	-1.495	2.911
2009-10	1.952	-0.791	-0.762	2.355	1.149	-1.552	3.504
2010-11	4.013	-0.728	-0.857	3.749	1.850	-1.585	5.599
2011-12	2.253	-0.673	-1.037	2.065	1.898	-1.710	3.963
2012-13	1.291	-0.630	-1.141	1.980	1.082	-1.770	3.062
2013-14	-0.103	-0.603	-1.140	0.631	1.009	-1.743	1.640
2014-15	-1.015	-0.590	-1.071	-0.252	0.897	-1.661	0.645
2015-16	-1.333	-0.580	-1.068	-0.473	0.787	-1.648	0.315
2016-17	-0.384	-0.571	-0.926	0.467	0.646	-1.497	1.113
2017-18	-0.229	-0.573	-0.856	0.641	0.558	-1.429	1.200
1990-2018*	3.021	-0.873	-0.287	3.891	0.290	-1.160	4.180

Source: Author's calculations
Remarks: * Average annual growth rate

Table 8
Decomposition of the difference in the increase in real output of China and India, 1990-2018.

Period	Difference in the increase in total output of China and India (Billion 2010 US $)	Difference in the increase in total output attributed to the difference in					
		Population size	Demographic dividend	Labour productivity	Participation opportunity	Demographic component	Economic component
1990	320	195	77	-166	214	272	48
1991	392	201	79	-114	226	280	112
1992	492	215	87	-60	249	302	189
1993	610	228	97	11	274	325	285
1994	726	242	107	75	302	349	377
1995	825	254	113	125	333	367	458
1996	923	266	128	166	364	394	530
1997	1044	272	134	249	390	406	639
1998	1138	278	137	305	418	415	723
1999	1216	286	146	334	450	432	784
2000	1359	290	158	435	476	448	911
2001	1503	293	173	546	491	466	1037
2002	1689	296	196	695	503	492	1198
2003	1879	304	230	822	524	534	1346
2004	2091	311	265	969	546	576	1515
2005	2368	321	298	1173	576	619	1749
2006	2725	332	334	1400	659	666	2059
2007	3198	345	367	1722	763	712	2485

Period	Difference in the increase in total output of China and India (Billion 2010 US $)	Difference in the increase in total output attributed to the difference in					
		Population size	Demographic dividend	Labour productivity	Participation opportunity	Demographic component	Economic component
2008	3597	343	380	2025	850	723	2875
2009	3958	347	393	2257	961	740	3218
2010	4412	354	405	2558	1095	759	3653
2011	4905	355	405	2897	1249	760	4146
2012	5333	353	392	3178	1410	745	4588
2013	5773	351	373	3492	1557	724	5049
2014	6192	350	348	3777	1718	698	5495
2015	6597	347	322	4041	1887	669	5928
2016	7008	342	289	4311	2066	631	6377
2017	7471	334	258	4635	2245	592	6880
2018	7956	322	224	4983	2428	546	7411

Source: Author's calculations